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ABSTRACT

Performance of forward observer students from the Army Field Artillery School at Fort Sill, Oklahoma was investigated in relation to several learner variables. Learner variables were field dependent/independent cognitive style, visual/haptic perceptual style, trait anxiety, scores on the Lorge-Thorndike Intelligence Tests, and achievement scores on the Sequential Tests of Educational Progress. These learner variables were investigated in relation to forward observers' performance in locating a target when given a map in a field, as measured in three different testing situations. Results indicated that under certain circumstances, field dependence, anxiety, and intelligence quotient had an effect upon performance. Regression analysis indicated, however, that the learner variables only accounted for 20 to 30 percent of the total variance. (A learning task review indicated possible problems with present instructional procedures, and suggestions for more complete investigations into the instructional sequence were submitted. (Author/GDC)

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Evaluation of Forward Observers

Session 4.10

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ABSTRACT

Performance of forward observer students from the Army Field Artillery School at Fort Sill was investigated in relation to several learner variables. Learner variables included in the study were field dependence - independence cognitive style, visual haptic perceptual style, trait anxiety, scores on the Lorge-Thorndike I.Q. scale, and achievement scores (the Sequential Test of Educational Progress). These learner variables were investigated in relation to forward observers performance as measured in three different testing situations throughout their training sequence.

Results indicated that under certain circumstances, field dependence, anxiety, and I.Q. had an effect upon performance. Regression analysis indicated, however, that the learner variables were only accounting for 20 to 30 percent of the total variance. A learning task review indicated possible problems with present instructional procedures, and suggestions for more complete investigations into the instructional sequence were submitted.

Introduction

In May of 1977 a study was released by the Director of Evaluation of the U.S. Army Field Artillery School entitled the Weapon System Training Effectiveness Analysis--The Forward Observer (WSTEA). This study (Phase Ia) was conducted to develop baseline data on the performance of forward observers in training and for forward observers who were "on the job," that is, were officers in field units. Performance was measured in terms of such factors as time and error involved in self and target location, number of rounds for adjustment of fire, percent of missions within 50 meters of target after fire for effect, average shoot scores, etc. In addition to performance data, certain aptitude and physiological measures were obtained and correlated with forward observer performance. Included in these measures were a standardized mathematics test, a nonverbal intelligence test, depth perception, eye-hand coordination, and visual acuity.

The results of the WSTEA Phase Ia investigation indicated that the typical forward observer is not able to locate self or the target within the standard time or accuracy (in meters) specified by Army Training and Evaluation Programs (ARTEP). The observers, however, were able to adjust fire on targets within ARTEP time and accuracy standards, as well as to achieve passing scores on course requirements. Results also indicated an increase in errors on ability to locate targets as time increased from the date of graduation (6 to 15 months). An interesting finding of the study was that previous map

reading grades, observed fire written test scores, standardized mathematics test scores, and nonverbal intelligence test scores were significantly related to target location error for the students in training at Fort Sill. Analysis of the data from 45 officers from field units indicated a relationship between mathematics ability, nonverbal I.Q., and observed fire written test for self location but not for target location. No relationships were evidenced for variables such as visual acuity, depth perception, number of practice missions, and other factors.

Thus, the results of the WSTEA Study indicate that the graduate of the basic course has difficulty in achieving accuracies specified by ARTEP in locating a target when given a map in the field. Although some significant relationships between variables were found, not enough information was obtained to construct a predictive model for success of a forward observer student. Conclusions indicated a possible problem with existing training in transferring needed skills for the task to the observer student.

PRESENT STUDY

The present study was done to further investigate the problems indicated by the WSTEA Study for the training of forward observers. The major thrust of the present study was to investigate the effect that various learner characteristics have upon ultimate forward observer performance. The learner characteristics included in this study were chosen because they seemed to be the most likely candidates for affecting performance given the present training procedures at the Field Artillery

School and given the skill requirements for successful performance of the forward observer's job.

One set of learner characteristics that was chosen because of its obvious relevance to a variety of learning and training tasks involved in forward observer training was that of cognitive style. The term cognitive style is generally assumed to represent the manner in which individuals receive, process, and use information. Of the several individual difference dimensions referred to as cognitive styles, two seemed to be most relevant to the tasks required of forward observers. These two cognitive styles are the field dependence-field independence cognitive style dimension (Witkin, Dyk, Faterson, Goodenough, & Karp, 1962) and the visual-haptic cognitive style dimension (Lowenfeld, 1945, 1970).

The cognitive style field dependence-field independence is one that has been thoroughly investigated over the last thirty years (e.g. Witkin, 1949, 1950a, 1950b, 1952, 1959; Witkin, Lewis, Hertzman, Machover, Miessner, & Wapner, 1954; Witkin et al. 1962; Witkin & Goodenough, 1976). This cognitive style was developed from studies investigating how individuals orient themselves in space or how they perceive the upright (Witkin, 1949, 1950b, 1952). In these studies, the visual field surrounding an individual and the kinesthetic cues or the pull of gravity on the body were investigated with regard to perception of the upright. It was found that individuals differ in their reliance upon each sensation for these perceptions. Some individuals were highly dependent on the visual field when determining

upright and were labeled field dependent (FD), while other individuals who used kinesthetic cues more and were less dependent on the visual field were labeled field independent (FI). In these early investigations these differences in perception were measured by the Rod-and-Frame Test (RFT) in which individuals were asked to adjust a rod to true vertical when it was surrounded by a tilted frame (Witkin, 1952). The test took place in a completely darkened room with no visual cues except for the position of the luminous rod and frame. Field independent individuals were able to adjust the rod to true vertical, while field dependent individuals would adjust the tilt of the rod to match the tilt of the frame (which made up the visual surroundings). Another test was devised by Witkin et al. (1971) and requires a subject to find a relatively simple geometric figure which is embedded in a more complex geometric figure. This test is referred to as the Embedded Figures Test (EFT). It was found that individuals who were most affected by the visual field (field dependent) also had difficulty in locating the simple figure; and those most affected by kinesthetic cues (in the RFT) found the simple figure rather easily. The EFT therefore has become a standard test when investigating the field dependent-field independent cognitive styles. Witkin et al. (1962) found in his investigations that the cognitive styles field dependence and field independence represented the ends of a continuum which he labeled psychological differentiations. The more differentiated individuals (FI) were found to differ from the less differentiated individuals (FD) in many ways. Field independent individuals were found to be analytical

in dealing with problem-solving situations and to impose structure on situations in which there was none. Field dependent individuals were less able to approach problems analytically or to impose structure in unstructured situations. Field dependents also seemed to have a less pronounced sense of separate identity and to rely more on the views of others for their sense of self and attitudes. On the other hand, field dependent individuals seem to excel in areas in which social skills become relevant. They are better able to get along with others, are better at conflict resolution, and are more aware of the feelings and needs of others. Recent neurophysiolgical studies have even indicated that perhaps there is greater lateralization of functions in each hemisphere of the brain of field independent individuals than of field dependent individuals. These studies seem to indicate many areas of differences for the individuals on each end of the psychological differentiation continuum (Ragan, Back, Stansell, Ausburn, Ausburn, Butler, & Huckabay, 1978).

It seems apparent that differences in ability to act analytically, provide structure, and to disembed an item from a complex context (such as in the location of self or target on a map) are differences that might have a profound effect upon the performance of certain tests (like those required of forward observers). It is for that reason that the cognitive styles field dependence-field independence were included in this study.

Another variable that developed out of the visual perception research is that of visual-haptic perceptual style. Most of the visual perception research deals with the way in which visual

information is processed. This research can be divided into two principal schools of thought. Arnheim (1969) and Piaget and Inhelder (1956) postulate that visual perception is a capacity which is essentially the same for all humans. Lowenfeld (1939), in contrast, argues that there are individual differences in the very nature of the perceptual-cognitive processes. Unlike Arnheim and Piaget, he does not believe that the formation of visual imagery is necessary for learning to occur. Consequently, he proposed two distinctly different perceptual types: the visual and the haptic type. According to Lowenfeld, the two types are completely different in their processing of visual information.

The visual perceptual type, in Lowenfeld's classification, depends primarily upon the eyes to provide sense impressions. The visual type is an observer and learns through visual imagery. The haptic type, on the other hand, is conceptualized as normally sighted but as less dependent on the eyes: this type depends on the "body-self," on various physical sensations, kinesthetic experiences, and tactile impressions. The haptic does not transform such sensations or experiences into visual ones but tends to subjectively feel them.

Lowenfeld (1945) developed a battery of five tests to distinguish visual types from haptics. The tests are based on the following theoretical formulations:

1. Whereas the visual has the ability to see a whole, break it up and see its component details, and then resynthesize the details back into a whole; the haptic is unable to do this.

2. Whereas the visual tends to react to stimuli as a spectator and to "see" experiences, the haptic tends to react emotionally, to "feel" stimuli, and to place self into the situation.

3. Whereas the visual has the tendency and ability to visualize and integrate tactile and partial experiences, the haptic has neither this tendency nor ability.

4. Whereas the visual has the ability to maintain visual imagery mentally, the haptic is unable to do this. (Ragan et al., 1978).

Of the tests developed by Lowenfeld, the Integration of Successive Impressions has been used in most of the visual-haptic research. A variation of this test for military use, the Successive Perception Test I (SPT-I), is in motion picture form. This form of the test contains 35 test items in which a moving slot reveals a drawing one part at a time. The subject watches the moving slot on the screen and then attempts to select from five similar drawings the one which matches what he saw behind the slot.

Some research (Erickson, 1964; Templeman, 1962) has shown relations between visual-haptic type and scholastic achievement, task performance, and rates of acquiring reading skills. Bruning (1974) found a significant relationship between visual aptitude and achievement in reading and mathematics for high school students. In addition, studies by Ausburn (1975) show interactions between instructional method and perceptual type.

Such findings in visual-haptic research suggest the possibility that this perceptual dimension may have implications for Army Forward Observer training. The SPT-1 was selected for administration to subjects to identify the two perceptual types. It was felt that this might isolate a learner variable which would be of importance in the map reading, self-and-target location process.

In addition to the cognitive style characteristics of the learner, several other variables were selected to be investigated with regard to their relationship to forward observer performance. One of these variables was trait anxiety. The Trait Anxiety Scale (Spielberger, Gorsuch, & Lushene, 1968) is the measure of this variable and represents the anxiety level that is characteristic of the individual over many situations. It represents the person's general level of anxiety and thus could be considered a personality trait. This variable, like the cognitive styles variables, might also have a profound effect upon the type learning and performance that is required of individuals training as forward observers. Since there is much stress associated with performing the forward observer's duties and an unusual need for precision in the tasks performed, it was assumed that anxiety might well be a learner characteristic that would be crucial to this study.

Additional variables that were cited by the WSTEA Study as probably affecting training and performance of the forward observers were also included in this study. Variables included in the study were the Lorge-Thorndike nonverbal intelligence

test and the Sequential Test of Educational Progress (STEP). these data are routinely collected by the Field Artillery School and were readily available for inclusion in the study.

In addition to the learner variable approach to the forward observer problem, a second avenue of investigation was a review of learning tasks. This review was done in order to provide an in-depth look at the skills necessary to successfully perform the tasks required of a forward observer in the field. It was hoped that this analysis would not only provide for a clearer understanding of how different learner variables affect performance but would also help to bring any problems with existing training into focus.

METHOD

The investigation of the variables described above in relation to the performance of forward observer trainees was accomplished by collecting several sets of data, including data obtained during the Map Reading subcourse taught by the Counterfire Department, and data obtained during the Observed Fire subcourse taught by the Gunnery Department. Data collected from these courses involved measures of ability to locate self and target. (These measures are described in more detail in the measures section of this paper.) These measures of performance were investigated in relation to each of the variables listed previously (i.e. cognitive style, anxiety, I.Q., etc.).

Subjects

Subjects for this investigation included 51 men involved in forward observer training at the Army Field Artillery School, Fort Sill, Oklahoma. Different analysis groups were used to investigate each of the learner variables. The composition of each of these analysis groups is discussed under the measures section for each of the learned variables (also see Appendix B).

Review of Learning Task

An additional component of the study was a review of learning tasks of the process of map reading. Although the sequence of instruction for teaching skills of location of self and target (taught within the two subcourses of map reading and observed fire) has been described in detail, the behavioral and

cognitive steps and the prerequisite abilities involved in successful use of these skills had not been properly indentified. This portion of the study attempted to identify cognitive behaviors, psychomotor skills, and other significant learning variables which affect the performance task. The potential benefit of the learning task review was to be the recognition of important cognitive or psychomotor skills which the present course of instruction was not designed to deal with. The learning task review was intended to provide a link between any learner variables which were discovered to be important (field dependence-field independence, visual-haptic, etc.) and the present course of instruction--possibly leading to adoption of alternate teaching methods.

Measures

Self-location scores from two blocks of instruction were utilized: from the Map Reading Section (Counterfire Department) and from the Observed Fire Section (Gunnery Department). These data were obtained as scores from current field exercises conducted with minor changes from current procedures to ensure reliability. Students' raw scores (errors in radial missed distance) were used in each analysis. Students whose raw scores were extreme (that is above 2100 meters) were recorded as 2100 meters for use in the analysis (see appendix B).

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The students' performance was measured at one station employed in Map Reading field excercises, and at two stations used in the Observed Fire field exercises.

A post-hoc analysis of the stations has revealed wide differences in the level of difficulty of the tasks at the three stations. Subsequent investigation showed that the first target was less difficult than the other two: at target one there were clearly defined points or landmarks, and the terrain, sloping toward the observer, allowed relatively easy orientation. The second target offered only one easily identifiable feature. In addition, the terrain was much more rolling and did not have the clearly defined terrain contours of target one. Target three was still more difficult, with gently sloping and no prominent features. This was also a "moving" shoot, traditionally the most difficult of gunnery shoots in an unfamiliar area. Therefore, data analysis and subsequent investigation show an unexpected increase in difficulty in target shoots two and three.

1. Measures of Self-location

From each station, one measure was taken on the student's ability to located self on the map. These measures were expressed in terms of radial missed distance, or the number of meters from the actual location the student's estimate was. This resulted in one score for each station, or a total of one score from the Map Reading field exercises and two scores from the Observed Fire field exercises. Station number one measures were taken at the very beginning of training. Station two measures were taken about one month into training; station three measures were taken at the end of training, about three weeks after the station two measures. A requirement for the gathering of these data was that

each student performed the self-location estimate independently at each testing location. A procedure in which the students submitted written estimates to the instructor, without discussion or help, was followed.

The data were analyzed in both original form (error in meters), and with regard to success in achievement of ARTEP standards ("yes/no").

2. Measures of Target-location

Target-location measures were also taken from the Map Reading and Observed Fire field exercises. As in the self-location measures, data were gathered at the same three field exercise stations. However, four measures of ability to locate four different targets were done at each station. These scores were then averaged to get a single average score of an individual's ability to locate targets at each station. This resulted in one score for Map Reading (station one) and two scores for Observed Fire field exercises (stations two and three). These measures were taken during the same time periods as the self-location measures (target locations were taken directly after self-location measures). These target-location estimates were collected in a fashion like that described above for self location, in which all students independently and simultaneously submitted their written target location estimates.

3. Cognitive Styles

a. Field dependence-field independence was measured by the Group Embedded Figures Test (Witkin et at., 1971), with upper and lower thirds of the scores designated as field

independent and field dependent, respectively. This resulted in 17 subjects classified as field dependent and 17 subjects as field independent. This group of 34 subjects was used in the analyses involving the field dependence learner variable. (See appendix B.)

b. The Successive Perception Test I (SPT-1) (U.S. Army Air Force, 1944) was used to measure the visual-haptic cognitive style. The individuals who scored in the top one third of the group were classified as visuals while those in the bottom third were classified as haptic. This resulted in 17 subjects classified as visual and 17 subjects classified as haptic. A total of 34 individuals were therefore used in the analysis of the visual-haptic cognitive sytle. (See appendix B.)

4. Measures Employed in Learning Task Review

The Learning task review produced by this study was accomplished through the following methods:

a. Observation of students in all possible settings (simulator, classroom, field shoot) performing the entire process of self and target location;

b. Examination of instructional materials such as programmed map readings, texts, media, and maps;

c. Interviews with students learning the map reading process, with instructors in Counterfire and Gunnery, and with graduates of Forward Observer training who might in retrospect offer analyses of the process which would contain significant differences from those of present students;

d. Comparison with the "thought process" formulated by experienced officers in the Gunnery department for student use.

5. Anxiety Measures

Measures of trait anxiety were obtained from the Trait Anxiety Scale (Spielberger, Gorsuch, and Lusherne, 1968). Comparison groups were obtained by the median-split technique with 23 individuals classified as low anxiety and 23 individuals classified as high anxiety. (See appendix B.)

6. Measures of Existing Data

Scores from the Sequential Test of Educational Progress (STEP) and the Lorge-Thorndike test were used in this study. These are standardized tests administered to each Officer Basic Course student before beginning the course; the data are collected, therefore, and available for processing. The scores on the two tests were treated by the median-split technique; that is, scores above the median were registered as "high" and those below as "low". The STEP comparison group was made up of 23 high STEP and 23 low STEP. The Lorge-Thorndike was made up of 22 individuals in the high group and 22 individuals in the low group. (See appendix B.)

Analysis of Data

Analysis of the learner variables in relation to the location of self and target was accomplished by parametric and nonparametric statistical techniques. Therefore, performance on the location of self task was investigated by a series of analysis of variance (ANOVA) and chi squares on the data collected during both Map Reading and Observed Fire subcourses. An additional set of identical analyses was also done on the task of target location over both of the subcourses. This was accomplished as follows:

1. A series of five 2 (learner variable) X 3 (station of field exercise) analysis of variance with repeated measures across the stations was done. The learner variables included: trait anxiety, field dependence-field independence, visual-haptic style, STEP scores, and Lorge-Thorndike scores. The other independent variable was three different field exercises, one exercise during the Map Reading subcourse (station one) and two field exercises during the Observed Fire subcourse (stations two and three). The dependent variable was the scores on the location of self in terms of meters of radial missed distance.

2. Another series of five 2 (learner variable) X 3 (station of field exercise) analysis of variance was done; however, this set utilized scores from location of target as the dependent variable.

3. A series of fifteen 2 (learner variable) X 2 (reached or did not reach criteria) chi squares using number of people reaching criteria on the self location exercises as the dependent variable was performed. One chi square was done for each station or field exercise for each learner variable (three stations times five learner variables equals fifteen chi squares performed).

4. A series of fifteen 2 (learner variable) X 2 (reached or did not reach criteria) chi squares using number of people reaching criteria on the target location exercises as the dependent variable was also done.

Statistical significance for these analyses was set at the .05 level. This was done even in the case of the numerous chi squares because as an initial investigation it was important to

pick up any possible differences that might occur. Any analysis that fell between the .05 and the .10 alpha level was also classified as approaching significance. The conclusions drawn from these analyses are tempered with this exploratory name of reference.

RESULTS

Analysis of Variance

1. Field dependence-field independence

a. location of self--The analysis of variance comparing field dependent versus field independent individuals on location of self indicated a significant difference between the two groups. Field dependent individuals performed significantly poorer than field independent individuals. The comparison of the performance on the three stations was also significant with consistently higher errors from station one to station two to station three (Appendix Table A).

b. location of target--The comparison between field dependent and field independent individuals approached significance (Appendix Table B) with field dependent individuals performing less well. The differences between the stations were again significant with increased errors from station one through station three.

2. Visual-haptic

a. location of self--A significant difference between stations was obtained with increasing errors from station one to station two, to station three (Appendix Table C).

b. location of target--An increase in errors from station one to station three was found as well as an interaction effect between visual-haptic and stations. Both approached significance (Appendix Table D). The interaction seems to be due to the visual groups's improvement on station number two and declining performance on station three to a level about equal to its station one performance, while the haptic group steadily declined from station one to three (see Figure 1).

3. Trait anxiety

a. location of self--A comparison of stations was significant with declining performance from station one to three (Appendix Table E).

b. location of target--The difference between the high trait anxiety and low trait anxiety groups approached significance with high anxiety individuals exhibiting poorer performance (Appendix Table F). Also, a significant station effect was again present with the same trend as in previous analyses.

4. Lorge-Thorndike scores

a. location of self--Again, the station effect was significant with the same trend as seen before (Appendix Table G).

b. location of target--The comparison of the high and low groups was significant, with the high I.Q. group performing better than the low I.Q. group (Appendix Table H).

5. STEP

a. location of self--A significant station effect was again found with the same pattern of differences as indicated in previous analyses (Appendix Table I).

b. location of target--Differences on the comparison for both stations and groups by stations interactions approached significance (Appendix Table J). An increase in performance for the last station on the low STEP score group seems to account for this interaction (see Figure 2).

Chi Squares

Of the thirty chi squares performed on the data, one was found significant, while two of the chi squares approached significance. The significant chi square was for location of target at station three where it appears that fewer individuals with high anxiety scores reached criteria than would have been expected (Appendix Table K). One of the chi squares that approached significance was for self location at station three, with high anxiety score individuals again failing to reach criteria in the numbers expected (Appendix Table K). The second chi square that approached significance was also at station three for target location with fewer individuals in the haptic group reaching the criteria level than would be expected (Appendix Table K).

Additional Analysis of Data

After reviewing the results of this data analysis, it was decided to do an additional set of analyses. These additional analyses were done in order to see if a predictive model could be devised using the five variables studied. These five variables were used as predictor variables to predict performance at the three different locations for both self and target location. The results of these six stepwise multiple linear

regressions are shown in the Appendix (see Tables L, M, N, O, P, and Q). This series of stepwise regressions shows that in each case, some linear combination of the learner variables did, with the exception of station two for self location, significantly predict performance of self and target location. As can be seen from Tables L, M, N, O, P, and Q in the Appendix, (R Square) the overall percentage of variance accounted for ranged from a low of approximately 10 percent to a high of approximately 30 percent. The order of variables entered into the linear combination was varied across the different tasks, but it appears that the four variables IQ, field dependence-field independence, visual-haptic, and anxiety are the most powerful. The IQ variable, as might be expected, entered the equation first on four of the five significant linear combinations. These results support the hypothesis that at least four of the learner variables do significantly predict performance of forward observers in field exercises. The regression analysis indicates that only 10 to 30 percent of the students' performance is accounted for by the learner characteristics (see R Square, Tables L, M, N, O, P, and Q), which suggests that other factors need to be considered.

Summary of Results

1. Field independent students perform better than field dependent students.
2. Students who score high on the Lorge-Thorndike perform better than those who score low on the Lorge-Thorndike test.
3. In some settings, students who are high in anxiety perform

poorer than those who are low in anxiety.

4. In terms of meters of radial missed distance, the students' average scores increase across stations for both location of self and target location (performance decreased).

5. The percentage of students reaching ARTEP criteria:

   a. increased across stations for target locations, and

   b. decreased across stations for location of self.

6. Learner characteristics provide a modest prediction of performance.

7. On the first estimation of target location, the majority of students did not reach ARTEP standards.

8. At station three, the majority of students did not meet ARTEP standards for location of target or location of self.

LEARNING TASK REVIEW

As stated above, the learning task review component of the study was intended to identify cognitive behaviors, psychomotor skills, and other significant learning variables which affect the performance of self and target location tasks. The learning task review was completed primarily through observation of students in field shoots, participation in orientation to and exercises with the BT-33 simulator, consideration of the "thought process" now in use, examination of instructional materials, and discussion with experienced field officers.

The learning task review was included in the research effort to provide an understanding of the relation to location tasks of any learner variables which were found to be significant.

That is, the task review was designated (1) to aid in interpreting any findings about important learner variables, and (2) to assist in making recommendations which are indicated by testing associated with the study.

Analysis of instructional materials and participation in representative classroom instruction have identified three types of learning which are emphasized by present instruction. These include knowledge of facts and tables, concept learning, and rule learning.

(1) Verbal Knowledge. Verbal knowledge of facts, tables, terms, procedures and other specifics is required of the student: many definitions, part names, discriminations, and procedures must be committed to memory if the student is to function successfully. For example, the student must commit to memory the terms used to provide marginal information: he must remember the meanings of "grid reference box," "scale," and "series number."

(2) Verbal Chains. Gagné (1970) defines this learning as "the learning of chains (two or more stimulus-response connections) that are verbal. Basically, the conditions resemble those for other (motor) chains. However, the presence of language in the human makes this a special type because internal links may be selected from the individual's previously learned repertoire of language." An example in forward observer training can be seen in the acquisition of the technique of calling in fire. The student must link a number of stimulus-response connections in order to learn the proper method of calling for fire.

(3) Concepts. Closely related to verbal knowledge of specifics is the process of concept formation. In concept learning, according to Gagné, "The learner acquires a capability of making a common response to a class of stimuli that may differ from each other widely in physical appearance. He is able to make a response that identifies an entire class of objects or events." Many of the concepts required of the F.O. student are defined and are learned by verbal cues. Other concepts are more concrete and are learned by reference to directly observable objects--as examples, the concept of a mil as part of a circle, the concept of designation of direction by use of mils, the concept of a "tic mark", the concept of a polar plot, or the concept of grid coordinate plotting.

(4) Rule Learning. In defining rule learning, Gagné states, "A rule is a chain of two or more concepts. It functions to control behavior by a verbalized rule of the form, If 'A then B,' where A and B are previously learned concepts." A "rule" in this sense is a particular case of concept use, not a "rule" in the regulation or social behavior sense. The F.O. student is repeatedly asked to learn rules: "If the target is a hand's width then it is 300 mils from reference point." In this case the prerequisite concepts include hand's width, the meaning of 300 mils, and the meaning of a reference point. It is clear that the concepts involved must be learned as concepts, not mere discriminations. When the student actually performs the target location and calling for fire task, it will be in a new situation in which specifics

are different from those encountered in previous situations. An additional example: "If 'X' circumstances are present, then 'Y' method of plotting is appropriate." In this case the prerequisite concepts include those such as polar plotting, grid coordinate plotting, adjustment of fire, grid coordinates, meter, mil, etc. Actual internalization of such concepts is essential before a student can understand the rule to the point of applying it generally.

Much forward observer instruction depends heavily on these three types of learning, and, additionally, requires of the learner certain basic visual-spatial perceptual skills. Although data from empirical aspects of this study do seem to indicate some impact on learner performance stemming from learner differences in visual-perceptual style, it would also appear that there is not adequate transfer of cognitive skills and strategies taught in classroom instruction to field performance in map reading and actual shoot exercises for students regardless of perceptual style. Students are not sufficiently able to generalize learning to performance situations.

Gagné theorized that "the most important considerations for lateral transfer appear to be internal to the individual." These internal conditions stem partly from prior learnings and partly from inherent learner characteristics. This study has identified learner characteristics which seem to be highly important in such transfer of knowledge: field dependence and level of anxiety, in particular. Prior learnings represent what instruction accomplishes (in retrospect) with each student.

Although learner characteristics are central to learning transfer, there is much that can be done in the instructional processes to provide a greater chance of learning transfer. Adequate and varied practice with new capabilities will improve transfer. Gagné explains that "the more broadly based a learned capacity, the better chance it will have to transfer to new and different situations. Accordingly, the usefulness of any learned capability will be increased if it is practiced in as wide a variety of situations as possible." He further adds that "the primary internal condition for vertical transfer is the mastery of the subordinate capabilities. Occurrence of vertical transfer is very improbable unless the relevant lower-order chains, concepts, or rules have been learned."

The learning task review has revealed what appears to be a major difficulty in the management of forward observer instruction: time deployed to practice of critical subordinate skills. Examination of timetables and observation of instruction indicated that time constraints may be detrimental to gaining prerequisite intellectual skills, particularly conceptual rules, which are necessary to performance in real situations. Time and type of learner performance required for acquisition of subordinate capabilities as concepts and rules, as opposed to discriminations and facts, does not appear to be provided. Additional time spent on instruction including learner performance is recommended for learning of the numerous concepts and rules underlying the target location task. Secondly, more practice--and more widely varied practice--is needed with new concepts and capabilities.

Broader experience and a wider range of experience seem likely to be of much value. Additional practice on the BT-33 simulator, for example, would be one means of obtaining greater transfer of instruction to the actual process of self and target location. However, many of the prerequisite learnings needed may be provided for through much simpler devices which would give needed examples and application practice on subordinate skills.

DISCUSSION

In an investigation of the training and performance of the forward observer students, at least four areas should be addressed: (1) the criteria for successful performance, (2) characteristics of the learner, (3) characteristics of the task, and (4) characteristics of the instruction. This study focuses upon the characteristics of the learner and secondarily upon the characteristics of the learning task.

The study indicates that some learner variables do have an effect upon the training and performance of forward observer personnel. In particular, field dependent individuals seem to have more difficulty in the tasks of target and self location than do field independent individuals. Also, high anxiety individuals tend to have more difficulty than do low anxiety individuals. The regression analysis indicated that certain learner characteristics are significant predictors of performance on self and target location tasks, although the amount of variance accounted for was relatively low (20 to 30 percent). It seems, therefore, that the learner variables in this investigation do have an effect upon performance. The level of

this effect does not suggest, however, that these variables can significantly account for performance differences. Although the results point to particular groups of individuals that are likely to have more difficulty with certain tasks than others, it is felt that a different approach is needed to elcuidate the differences in performance.

As was indicated in the analysis section of this paper, there was an increase in number of individuals reaching ARTEP criteria from station one to the next two stations (see Table 3). However, there was a decrease in the mean scores of individuals across those same stations (see Table 2). The standard deviations associated with these means were quite high and showed a steady increase across the stations when measured for target location. Normally it would be expected that a decrease in variance would appear as the amount of training increased. The increase in variance seen in this investigation across stations may point to problems associated with delivery of the training. This was somewhat supported by the task analysis where it was found that students were not being given sufficient opportunity to learn skills at the necessary level to successfully perform the tasks.

Although the increase in difficulty of the performance tests from station one to station three may be assumed to have an impact on performance level and variability, one should also be able to assume that the most difficult test, station three, was in fact a test of skills to be learned in the F.O. course. A decrement in performance, then, should be a springboard for

further careful study of both the validity and appropriateness of the test employed and to the sufficiency of instruction provided to learn the skills at hand.

The results of this study do not provide a complete answer to the question of whether individuals can be taught the skills necessary to become successful forward observers (at least to reach ARTEP standards). It appears from the results that under certain conditions in which performance is exhibited, certain variables, such as anxiety, intelligence, or level of field dependence, may have an effect. On the other hand, other variables such as the characteristics of the learning task, testing situation, and the type and sequencing of the instruction, also have a profound effect, and appear to the authors of this study to be the realm of greatest potential benefit for further work. In other words, from viewing learning characteristics, learning tasks, instruction and evaluation it is our opinion that the goals of the course and the ARTEP standards behind them are achievable by most learners given appropriate instruction. It is the suggestion of the authors that pilot work be initiated to find and develop improved instruction, with an emphasis on provision of sufficient and appropriate treatments and practice for learning necessary prerequisite skills. Appendix A provides a brief description of a suggested approach to this recommendation.

Table 1

Mean and Standard Deviation Scores for Selected Learner Variable Groups

Learner Variable Groups	Mean	Standard Deviation
Target location scores		
Field dependence	741.10	467.95
Field independence	532.27	426.44
Low anxiety	526.54	396.38
High anxiety	670.19	420.26
Low IQ	675.24	455.99
High IQ	475.15	317.87
Self location scores		
Field dependence	156.47	196.97
Field independence	81.37	102.45

Table 2

Mean and Standard Deviation Scores Based on 46 Subjects for Trials (Different Field Exercises) Across Self and Target Locations

Trial	Mean	Standard Deviation
Location of self		
Station one	69.56	196.49
Station two	89.13	141.78
Station three	196.30	135.67
Location of target		
Station one	526.07	288.13
Station two	553.48	455.84
Station three	696.06	520.61

Table 3

Number and Percentages of Individuals Reaching ARTEP Standards Across the Three Stations for Self and Target Location (N=46)

		Station 1	Station 2	Station 3
Self Location	raw score	43	41	14
	percentage	93.5	89.1	30.4
Target Location	raw score	1	15	16
	percentage	2.2	32.6	34.8

Figure 1

Radial Missed Distance Scores for Visual and Haptic Groups Across Stations

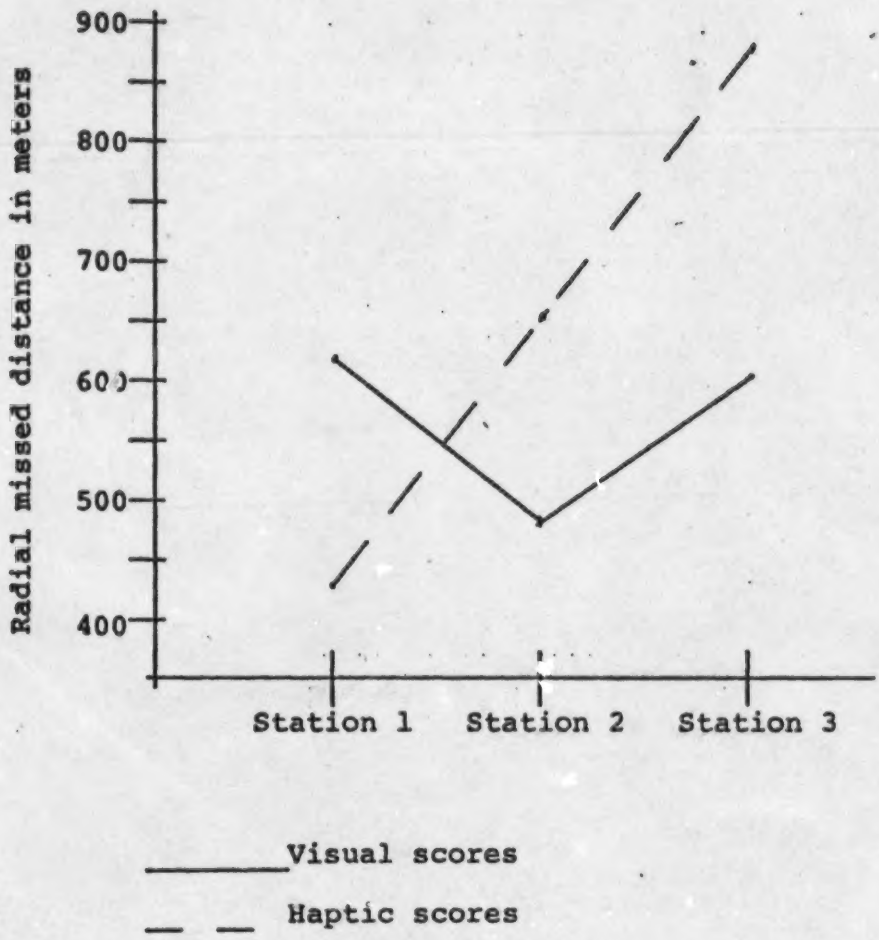
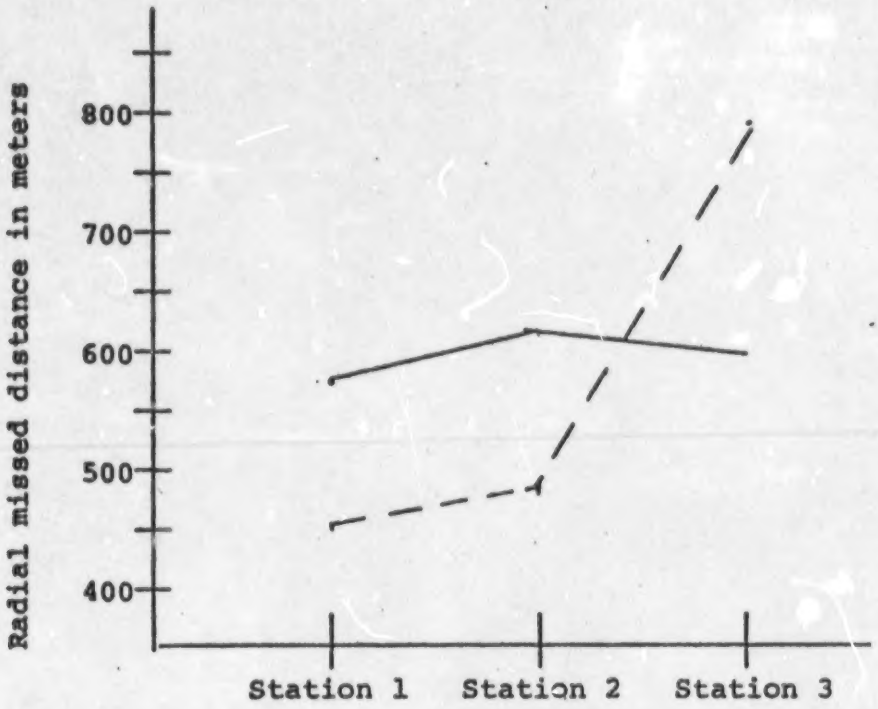


Figure 2

Radial Missed Distance Scores for Low and High STEP Score Groups Across Stations



APPENDIX

Table A

Repeated Measures Analysis of Variance of Location of Self Scores for Field Dependent and Field Independent Groups Across Three Different Field Exercise Stations

Source of Variation	df	MS	F	p
Between subjects	33	23831.75		
Groups	1	143813.00	7.16	.0112
S/G (error)	32	20082.34		
Within subjects	68	26793.14		
Trials	2	186460.00	7.25	.0009
GT (interaction)	2	1224.00	.05	.09472
TS/G (error)	64	22602.59		

Group Means

Field dependent	156.47
Field independent	81.37

Trial Means

Station one	67.64
Station two	85.29
Station three	203.82

Group by Trial Means

	Station 1	Station 2	Station 3
Field dependent	111.76	117.64	240.00
Field independent	23.53	52.94	167.65

Table B

Repeated Measures Analysis of Variance of Location of Target Scores for Field Dependent and Field Independent Groups Across Three Different Field Exercise Stations

Source of Variation	df	MS	F	p
Between subjects	33	341415.25		
Groups	1	1111984.00	3.50	.0672
S/G (error)	32	317335.00		
Within subjects	68	145394.06		
Trials	2	453024.00	3.34	.0404
GT (interaction)	2	155248.00	1.15	.3246
TS/G (error)	64	135472.75		

Group Means

Field dependent	741.10
Field independent	532.27

Trial Means

Station one	521.82
Station two	635.56
Station three	752.68

Group by Trial Means

	Station 1	Station 2	Station 3
Field dependent	599.18	816.88	807.24
Field independent	444.47	454.24	698.12

Table C

Repeated Measures Analysis of Variance of Location of Self Scores for Visual and Haptic Groups Across Three Different Field Exercise Stations

Source of Variation	df	MS	F	p
Between subjects	25	30371.28		
Groups	1	2954.00	0.09	.7596
S/G (error)	24	31513.66		
Within subjects	52	32056.42		
Trials	2	139261.50	5.28	.0086
GT (interaction)	2	60800.00	2.30	.1089
TS/G (error)	48	26391.89		

Group Means

Visual	115.38
Haptic	127.69

Trial Means

Station one	61.54
Station two	100.00
Station three	203.07

Group by Trial Means

	Station 1	Station 2	Station 3
Visual	107.69	84.62	153.85
Haptic	15.38	115.38	252.31

Table D

Repeated Measures Analysis of Variance of Location of Target Scores for Visual and Haptic Groups Across Three Different Field Exercise Stations

Source of variation	df	MS	F	p
Between subjects	25	364778.19		
Groups	1	132512.00	0.35	.5640
S/G (error)	24	374456.00		
Within subjects	52	154268.88		
Trials	2	346352.00	2.53	.0888
GT (interaction)	2	372208.00	2.71	.0748
TS/G (error)	48	137184.63		

Group Means

Visual	574.36
Haptic	656.79

Trial Means

Station one	527.92
Station two	572.46
Station three	746.35

Group by Trial Means

	Station 1	Station 2	Station 3
Visual	622.85	483.54	616.69
Haptic	433.00	661.38	876.00

Table E

Repeated Measures Analysis of Variance of Location of Self Scores for Low and High Anxiety Groups Across Three Different Field Exercise Stations

Source of Variation	df	MS	F	p
Between subjects	45	16637.11		
Groups	1	32875.00	2.02	.1588
S/G (error)	44	16268.07		
Within subjects	92	23644.20		
Trials	2	186658.50	9.38	.0004
GT (interaction)	2	25137.00	1.27	.2874
TS/G (error)	88	19905.41		

Group Means

Low anxiety	93.48
High anxiety	124.35

Trial Means

Station one	54.35
Station two	93.48
Station three	178.91

Group by Trial Means

	Station 1	Station 2	Station3
Low anxiety	47.83	95.65	136.96
High anxiety	60.87	91.30	220.87

Table F

Repeated Measures Analysis of Variance of Location of Target Scores for Low and High Anxiety Groups Across Three Different Field Exercise Stations

Source of Variation	df	MS	F	p
Between subjects	45	235003.38		
Groups	1	711936.00	3.18	.0781
S/G (error)	44	224164.00		
Within subjects	92	139522.06		
Trials	2	459104.00	3.41	.0363
GT (interaction)	2	37704.00	0.28	.7602
TS/G (error)	88	134572.88		

Group Means

Low anxiety	526.54
High anxiety	670.19

Trial Means

Station one	498.35
Station two	598.59
Station three	698.15

Group by Trial Means

	Station 1	Station 2	Station 3
Low anxiety	459.26	514.39	605.96
High anxiety	537.43	682.78	790.35

Table G

Repeated Measures Analysis of Variance of Location of Self Scores for Low and High IQ Scores Across Three Different Field Exercise Stations

Source of Variation	df	MS	F	p
Between subjects	43	24374.00		
Groups	1	44734.00	1.87	.1753
S/G (error)	44	23889.23		
Within subjects	88	28961.36		
Trials	2	208128.00	8.43	.0007
GT (interaction)	2	28779.00	1.17	.3170
TS/G (error)	84	24699.83		

Group Means

Low IQ	133.03
High IQ	96.21

Trial Means

Station one	70.45
Station two	79.54
Station three	193.86

Group by Trial Means

	Station 1	Station 2	Station 3
Low IQ	118.18	86.36	194.55
High IQ	22.73	72.73	193.18

Table H

Repeated Measures Analysis of Variance of Location of Target Scores for Low and High IQ Scores Across Three Different Field Exercise Stations

Source of Variation	df	MS	F	p
Between subjects	43	262337.44		
Groups	1	1321200.00	5.57	.0217
S/G (error)	42	237126.44		
Within subjects	88	128345.25		
Trials	2	245424.00	1.91	.1514
GT (interaction)	2	25224.00	0.20	.8232
TS/G (error)	84			

Group Means

Low IQ	675.24
High IQ	475.15

Trial Means

Station one	527.57
Station two	536.75
Station three	661.27

Group by Trial Means

	Station 1	Station 2	Station 3
Low IQ	609.64	627.59	788.50
High IQ	445.50	445.91	534.05

Table I

Repeated Measures Analysis of Variance of Location of Self Scores for Low and High STEP Scores Across Three Different Field Exercise Stations

Source of Variation	df	MS	F	p
Between subjects	45	23466.09		
Groups	1	50122.00	2.19	.1422
S/G (error)	44	22860.27		
Within subjects	92	28499.28		
Trials	2	234274.50	9.77	.0003
GT (interaction)	2	21578.50	0.90	.5870
TS/G (error)	88	23979.86		

Group Means

Low STEP	133.04
High STEP	94.93

Trial Means

Station one	69.57
Station two	76.09
Station three	196.30

Group by Trial Means

	Station 1	Station 2	Station 3
Low STEP	113.04	78.26	207.83
High STEP	26.07	73.91	184.78

Table J

Repeated Measures Analysis of Variance of Location of Target Scores for Low and High STEP Groups Across Three Different Field Exercise Stations

Source of Variation	df	MS	F	p
Between subjects	45	284774.38		
Groups	1	37664.00	0.13	.7210
S/G (error)	44	290390.50		
Within subjects	92	143847.13		
Trials	2	383200.00	2.86	.0607
GT (interaction)	2	347408.00	2.60	.0783
TS/G (error)	88	133780.88		

Group Means

Low STEP	608.39
High STEP	575.35

Trial Means

Station one	526.06
Station two	553.48
Station three	696.07

Group by Trial Means

	Station 1	Station 2	Station 3
Low STEP	587.87	624.91	612.39
High STEP	464.26	482.04	779.74

Table K

Chi Squares Analysis of Selected Learner Characteristics Groups Reaching or Failing to Reach ARTEP Standards at Station Three

Learner Characteristic	Number in category: Reaching Criteria	Not Reaching Criteria	df	Chi Square	p
Location of Self					
Low anxiety group	12	11			
High anxiety group	5	18			
			1	3.359	.0636
Location of Target					
Low anxiety group	10	13			
High anxiety group	3	20			
			1	3.86	.0468
Visual group	6	7			
Haptic group	1	12			
			1	3.128	.0735

Table L

Summary Table for Regression Analysis Prediction of Performance at Station 1 for Location of Self

Variable	Multiple R	R Square	RSq. Change	Std. Error	F
IQ	.379	.143	.143	183.911	7.367**
Visual-Haptic	.459	.211	.067	178.579	5.740**
STEP	.463	.214	.004	180.262	3.822*
FD-FI	.465	.216	.001	182.282	2.822*

* $p < .05$

** $p < .01$

Table M

Summary Table for Regression Analysis Prediction of Performance at Station 2 for Location of Self

Variable	Multiple R	R Square	RSq. Change	Std. Error	F
Anxiety	.215	.046	.046	140.037	2.127
STEP	.274	.075	.029	139.490	1.745
Visual-Haptic	.303	.092	.017	139.854	1.416
FD-FI	.307	.094	.003	141.350	1.068
IQ	.309	.096	.001	142.998	.847

Table N

Summary Table for Regression Analysis Prediction of Performance at Station 3 for Location of Self

Variable	Multiple R	R Square	RSq. Change	Std. Error	F
IQ	.362	.131	.131	127.877	6.651*
Anxiety	.446	.199	.068	124.192	5.351**
Visual-Haptic	.507	.257	.057	121.078	4.833**
FD-FI	.525	.276	.019	120.941	3.907**
STEP	.526	.277	.001	122.391	3.059*

* $p < .05$

** $p < .01$

Table O

Summary Table for Regression Analysis Prediction of Performance at Station 1 for Location of Target

Variable	Multiple R	R Square	RSq. Change	Std. Error	F
IQ	.435	.189	.189	262.335	10.285**
Visual-Haptic	.518	.269	.079	252.081	7.895**
FD-FI	.534	.285	.017	252.149	5.586**
Anxiety	.541	.293	.008	253.809	4.248**
STEP	.548	.301	.008	255.582	3.438*

* $p < .05$

** $p < .01$

Table P

Summary Table for Regression Analysis Prediction of Performance at Station 2 for Location of Target

Variable	Multiple R	R Square	RSq. Change	Std. Error	F
FD-FI	.400	.160	.160	422.500	8.382**
IQ	.431	.186	.026	420.779	4.906*
Anxiety	.460	.212	.026	418.915	3.761*
Visual-Haptic	.462	.213	.002	423.526	2.782*
STEP	.464	.215	.002	428.372	2.191*

* $p < .05$

** $p < .01$

Table Q

Summary Table for Regression Analysis Prediction of Performance at Station 3 for Location of Target

Variable	Multiple R	R Square	RSq. Change	Std. Error	F
IQ	.392	.154	.154	484.213	8.019**
Visual-Haptic	.447	.200	.046	476.280	5.383**
FD-FI	.458	.209	.009	479.166	3.707*
Anxiety	.470	.221	.012	481.417	2.906*
STEP	.478	.228	.007	485.169	2.363

* $p < .05$

** $p < .01$

APPENDIX A

A Recommended Pilot Instructional Development for Forward Observer Training

The following briefly describes a recommended approach to development of alternative, improved instruction designed to increase target location skills.

Purpose: to design, develop, and field test one or more training approaches for target location skills in order to:

1. determine the extent to which performance on target location to ARTEP standards of time and distance are feasible training goals (e.g., to determine the extent to which trainees can be taught these skills).
2. develop and validate instructional strategies and materials which are effective in training for target location with a substantial proportion of a trainee population.

Assumptions/Conditions

1. Student time is available for trial development and validation of alternative instructional approaches.
2. Facilities and field time are available for trial development and validation.
3. Instructors are available for trial development and validation.
4. Experimental populations of students and instructors may be drawn upon (i.e. that latitude exists to put some forward observer students through a different, experimental training sequence).

Approach

Given information and experience from the current study, as well as other relevant previous research and experience, a team composed of Army personnel and a contracted agency would attempt to find and develop approaches to training in target location which are more effective than current training.

Working with individuals, small groups, and large groups of trainees, the intellectual skills and strategies leading to the terminal performance (target location) would be found and instructional delivery systems would be developed and field tested.

As a body of validated approaches to achievement of prerequisite skills is developed, these isolated, experimentally devised and implemented instructional approaches will be articulated together from the standpoint of interface with training conditions and constraints which exist for the entire forward observer course. Recommendations will be made with regard to changes needed in the course. In other words, before embarking on a redevelopment of the course itself, tested and validated approaches to the improvement of target location skills need to be available.

APPENDIX B

Subject	GEFT raw score	GEFT group	SPT-1 raw score	SPT-1 group	Trait Anxiety raw score	Trait Anxiety group	STEP raw score	STEP group	Lorge-Thorndike raw score	Lorge-Thorndike group
1	15		18	Hap	36	Hi	302	Hi	51	Lo
2	6	FD	15		44	Hi	293	Lo	49	Lo
3	13		11		38	Hi	293	Lo	58	Hi
4	17	FI	13		31	Lo	279	Lo	57	Hi
5	16	FI	18	Hap	20	Lo	279	Lo	58	Hi
6	11	FD	15		35	Hi	305	Hi	53	Lo
7	13		16	Hap	23	Lo	309	Hi	58	Hi
8	15		7	Vis	32	Lo	293	Lo	59	Hi
9	16	FI	11		22	Lo	295	Lo	52	Lo
10	12		11		42	Hi	293	Lo	49	Lo
11	15		11		42	Hi	291	Lo	53	Lo
12	10	FD	19	Hap	28	Lo	287	Lo	46	Lo
13	17	FI	8	Vis	33	Lo	310	Hi	65	Hi
14	18	FI	14		23	Lo	307	Hi	57	Hi
15	11	FD	17	Hap	40	Hi	298	Hi	56	Hi
16	18	FI	13		33	Lo	314	Hi	52	Lo
17	16	FI	9	Vis	32	Lo	295	Lo	50	Lo
18	15		10	Vis	38	Hi	302	Hi	53	Lo
19	15		12		25	Lo	300	Hi	53	Lo
20	8	FD	13		37	Hi	283	Lo	49	Lo
21	18	FI	13		33	Lo	303	Hi	69	Hi
22	7	FD	16	Hap	44	Hi				
23	13		15		25	Lo				
24	11	FD	10	Vis	38	Hi				
25	18	FI	14		33		297	Lo	53	
26	15		10	Vis	34	Hi	314	Hi	66	Hi
27	9	FD	10	Vis	33		281	Lo	31	Lo
28	17	FI	8	Vis	51	Hi	297	L0	58	Hi
29	4	FD	14		39	Hi	300	Hi	44	Lo
30	6	FD	10	Vis	33		295	Lo	47	Lo
31	15	FI	13		29	Lo	300	Hi	47	I
32	16	FI	13		33		303	Hi	56	Hi
33	11		10	Vis	31	Lo	300	Hi	50	Lo
34	10	FD	18	Hap	58	Hi	285	Lo	56	Hi
35	13		24	Hap	33		298	Hi	57	Hi
36	16	FI	14		40	Hi	305	Hi	62	Hi
37	3	FD	12		24	Lo				
38	10	FD	11		34	Hi	289	Lo	42	Lo

Subject	GEFT raw score	GEFT group	SPT-1 raw score	SPT-1 group	Trait Anxiety raw score	Trait Anxiety group	STEP raw score	STEP group	Lorge-Thorndike raw score	Lorge-Thorndike group
39	15	FI	15	Hap	40	Hi	306	Hi	53	
40	18	FI	7	Vis	32	Lo	316	Hi	65	Hi
41	12		9	Vis	34	Hi	285	Lo	62	Hi
42	7	FD	11		22	Lo	316	Hi	55	Hi
43	12		17	Hap	37	Hi	281	Lo	43	Lo
44	14		14		23	Lo	[illegible]6	Hi	55	Hi
45	7	FD	10		32	Lo	291	Lo	57	Hi
46	2	FD	17	Hap	40	Hi	289	Lo	23	Lo
47	16	FI	12		28	Lo				
48	17	FI	19	Hap	40	Hi	303	Hi	51	Lo
49	11		7	Vis	31	Lo	285	Lo	63	Hi
50	14		14		27	Lo	291	Lo	49	Lo
51	11	FD	22	Hap	37	Hi	298	Hi	56	Hi

FD - Field Dependent
FI - Field Independent
Vis - Visual Perceptual Style
Hap - Haptic Perceptual Style
Lo - Low
Hi - High

Subject	March 29 Self	Target 1	Target 2	Target 3	Target 4	Target Avg.	May 11 Self	Target 1	Target 2	Target 3	Target 4	Target Avg.	May 23 Self	Target 1	Target 2	Target 3	Target 4	Target Avg.
1	0	100	900	900	300	550	0	1670	2100+	200	200	1040	300	1290	1350	400	650	923
2	0	100	400	600	100	300	0	200	800	0	800	450	300	1150	800	890	680	880
3	100	600	200	350	400	387	0	100	2100+	800	100	775	200	1090	500	100	400	548
4	0	575	400	770	600	586	100	100	200	1000	100	350	300	1000	1430	1320	100	963
5	0	200	400	700	600	480	300	100	730	300	700	457	200	800	300	100	200	350
6	0	150	400	940	400	472	0	850	350	400	500	525	300	1010	1000	1510	1590	1278
7	0	500	300	700	300	450	100	200	675	600	100	393	200	200	300	200	600	325
8	0	500	400	675	300	468	100	100	300	100	0	125	200	0	100	0	200	75
9	0	300	350	400	200	312	0	0	100	300	0	100	0	300	200	200	300	250
10	900	1100	900	1000	1000	1000	0	1900	850	780	100	908	200	100	200	0	400	175
11	0	630	500	200	300	407	0	0	100	200	780	270	200	300	100	0	600	250
12	0	350	0	600	100	262	100	0	100	100	100	75	200	0	100	100	350	138
13	0	100	400	500	650	410	0	100	775	100	700	418	200	0	200	0	680	220
14	0	0	300	730	300	332	100	0	100	0	100	50	200	100	0	0	800	225
15	0	0	300	770	770	460	100	100	100	100	500	200	400	1040	890	1640	1250	1205
16	100	500	100	675	300	393	100	1000	350	0	400	438	200	200	100	100	550	238
17	100	730	630	200	800	590	0	1000	1020	950	1140	1028	100	500	1000	1730	1100	1083
18	0	2100	400	300	400	812	100	100	200	0	1200	375	200	1080	1150	1490	1280	1250
19	0	550	300	675	600	530	400	0	575	0	900	368	0	1260	1280	1860	1370	1443
20	100	300	100	2000	400	700	300	2100	1130	220	500	988	200	200	300	700	800	500
21	0	0	300	600	0	225	0	2100+	580	0	100	695	350	1040	1060	1780	1940	1455
22	100	400	200	400	100	425	100	1620	2100+	900	1340	1485	200	100	1010	300	1220	658
23	100	300	100	500	200	275	100	1500	2100+	920	1100	1405	100	930	1220	1510	1530	1298
24	100	675	715	1250	1300	1000	600	2100+	1300	300	900	1750	100	1020	1200	1290	850	1090
25	100	350	100	1100	675	556	0	2100+	2100+	1740	1430	1843	300	1010	1200	1780	1800	1448
26	0	300	300	800	300	425	0	0	300	0	0	75	200	0	0	0	300	75
27	1000	1200	2050	2050	2100	1850	100	2100+	940	100	100	810	300	1430	1610	2100+	2100+	1810
28	0	300	300	800	300	430	0	0	200	0	100	75	200	0	200	800	730	433
29	100	550	300	600	100	387	0	1350	2100+	1160	1200	1453	300	600	800	1450	1210	689
30	100	400	100	600	850	487	0	300	1060	300	300	490	200	0	300	100	200	150
31	0	100	500	700	200	375	0	100	400	0	0	125	0	1060	300	650	400	603
32	0	1200	500	500	300	625	0	0	600	0	300	225	200	200	0	0	780	245
33	100	350	100	575	100	281	100	1120	1580	900	1050	1163	100	1820	1810	2100+	730	1206

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Subject	March 29 Self	Target 1	Target 2	Target 3	Target 4	Target Avg.	May 11 Self	Target 1	Target 2	Target 3	Target 4	Target Avg.	May 23 Self	Target 1	Target 2	Target 3	Target 4	Target Avg.
34	0	200	100	630	200	282	0	1930	2100+	1250	930	1553	200	200	650	100	700	413
35	0	300	200	770	100	342	0	0	650	100	0	187	400	800	850	1450	2100+	1300
36	0	350	200	800	450	450	100	0	2100+	0	400	625	200	1000	1090	700	1330	1030
37	100	600	300	730	300	482	0	1090	930	220	300	635	200	550	850	200	300	475
38	0	200	1075	1500	600	843	0	100	640	0	200	235	100	900	100	100	1320	605
39	0	300	450	650	300	430	0	0	200	0	100	75	200	1420	1000	1620	1860	1475
40	0	100	400	625	450	393	0	0	200	0	200	100	0	0	0	0	1000	250
41	0	500	500	950	650	650	0	0	730	200	580	377	0	0	0	0	400	100
42	100	300	900	1500	1150	962	400	800	1480	1200	1340	1305	100	1350	1220	1010	1300	916
43	0	600	350	300	400	412	500	580	2100+	630	680	998	200	1200	1140	2100+	1350	1448
44	200	300	500	500	300	400	0	0	1100	1000	0	525	100	100	0	0	630	183
45	100	100	200	700	400	350	100	0	820	680	800	575	100	200	350	100	200	213
46	0	100	400	450	1300	562	100	1390	1720	1090	1430	1408	780	1490	1420	2100+	2000	1753
47	100	300	200	700	400	400	100	2100+	1120	750	100	1018	0	1140	1420	1780	1770	1528
48	0	650	350	900	550	612	100	100	400	200	0	175	0	200	300	700	600	450
49	0	200	400	630	400	332	100	100	200	0	100	100	200	200	200	300	400	275
50	0	100	2100+	2100+	800	1275	0	200	880	100	350	383	100	100	100	0	700	225
51	0	200	400	350	500	362	100	100	2100+	0	0	550	100	1010	1010	1230	550	950

REFERENCES

Arnheim, R. Visual thinking. Los Angeles: University of California Press, 1969

Ausburn, F. B. Multiple versus linear imagery in the presentation of a comparative visual location task to visual and haptic college students. Unpublished doctoral dissertation, University of Oklahoma, 1975.

Bruning, W. A. Visual aptitude as it relates to student achievement in reading and mathematics. Unpublished doctoral dissertation, University of Oklahoma, 1974.

Erickson, R. C. Visual-haptic aptitude: Effect on mechanical drawing achievement. Journal of Industrial Teachers, 1964, 2, 40-46.

Gagné, R. M. The conditions of learning. New York: Holt, Rinehart, & Winston, 1970.

Lowenfeld, V. The nature of creative activity: Experimental and comparative studies of visual and non-visual sources. London, 1939.

Lowenfeld, V. Tests for visual and haptical aptitudes. American Journal of Psychology, 1945, 58, 100-112.

Lowenfeld, V. Creativity and mental growth (5th ed.). New York: MacMillan, 1970.

Piaget, J., & Inhelder, B. The child's conception of space. New York: The Humanities Press, 1956.

Ragan, T. J., Back, K. T., Stansell, V., Ausburn, L. J., Ausburn, F. B., Butler, P. A., & Huckabay, K. Cognitive styles: A review of the literature (F33615-77-C-0047), Air Force Human Resources Lab, Lowry AFB, Co., 1978. (to be published summer, 1978)

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. State-trait anxiety scale. 1968.

Templeman, K. D. A study of the relationship between the haptic and visual creative types and reading achievement in first and sixth grade children. Unpublished master thesis, Cornell University, 1962.

Witkin, H. A. Perception of body position and of the position of the visual field. Psychological Monographs, 1949, 63, 1-46.

Witkin, H. A. Individual differences in ease of perception of embedded figures. Journal of Personality, 1950, 19, 1-15. (a)

Witkin, H. A. Perception of the upright when the direction of the force acting on the body is changed. Journal of Experimental Psychology, 1950, 40, 93-106. (b)

Witkin, H. A. Further studies of perception of the upright when the direction of the force acting on the body is changed. Journal of Experimental Psychology, 1952, 43, 9-20.

Witkin, H. A. The perception of the upright. Scientific American, 1959, 3-8.

Witkin, H. A. Psychological differentiation and forms of pathology. Journal of Abnormal Psychology, 1965, 70, 317-336.

Witkin, H. A., Dyk, R. B., Faterson, H. F., Goodenough, D. R., & Karp, S. A. Psychological differentiation. New York: Wiley, 1962.

Witkin, H. A., & Goodenough, D. R. Field dependence revisited (ETS RB 76-39). Princeton, N. J.: Educational Testing Service, 1976.

Witkin, H. A., Lewis, H. B., Hertzman, M., Machover, K., Meissner, P. B., & Wapner, S. Personality through perception. New York: Harper & Row, 1954.

Witkin, H. A., Oltman, P. K., Raskin, E., & Karp, S. A. A manual for the embedded figures test. Palo Alto, Ca.: Consulting Psychologists Press, 1971.